Development of High-Reflectivity Optical Coatings for the Vacuum Ultraviolet and Verification on a Sounding Rocket Flight

Completed Technology Project (2013 - 2017)

Project Introduction

We desire to develop new thin film coatings of fluorides to utilize the high intrinsic reflectivity of aluminum. Highly controllable thickness of fluorides can be attained through Atomic Layer Deposition (ALD). We propose to create highly transmissive protective thin film coating layers to improve aluminum reflectance to greater than 60 % around the wavelength of 90 nm. Our more ambitious goal is to enhance the reflectance down to 80 nm. We also aspire to explore material combinations and possible other deposition processes for effective coatings. These new coatings are aimed at advancing space technology by addressing Strategic Goal 3.2, Infuse game-changing and crosscutting technologies through the Nation's space enterprise to transform the Nation's space mission capabilities. Our primary mechanism for laying down these very thin coatings will be with ALD at NASA's Jet Propulsion Laboratory. We will implement this technique to obtain high reflectance coatings for use on a future UV/Visible satellite mission. We will use ALD to create thin layers MgF2 on aluminum. Laboratory tests of the coating reflectance will be performed with the vacuum facilities at the University of Colorado. Verification of space flight quality coatings will be performed by applying the coatings to the optics of my dissertation sounding rocket flight. Our ALD coatings will be taken from Technology Readiness Level (TRL) 3 to TRL level 9 during my graduate school career. These new coatings will open access to new plasma diagnostics in astrophysics and solar physics , allow for more advanced instrumentation , mitigate the need for very large primary mirrors in the vacuum ultraviolet and thus enabling lighter payloads which in turn will lower launch costs. The new ALD coatings will be designed to directly tackle the Observatory Technology Challenge, 8.2.1 Large Mirror Systems, 8.2.1.2 Normal Incidence need of Reflectivity > 60 % for 90 900 nm.

Anticipated Benefits

These new coatings will open access to new plasma diagnostics in astrophysics and solar physics , allow for more advanced instrumentation , mitigate the need for very large primary mirrors in the vacuum ultraviolet and thus enabling lighter payloads which in turn will lower launch costs. The new ALD coatings will be designed to directly tackle the Observatory Technology Challenge, 8.2.1 Large Mirror Systems, 8.2.1.2 Normal Incidence need of Reflectivity > 60 % for 90 900 nm.

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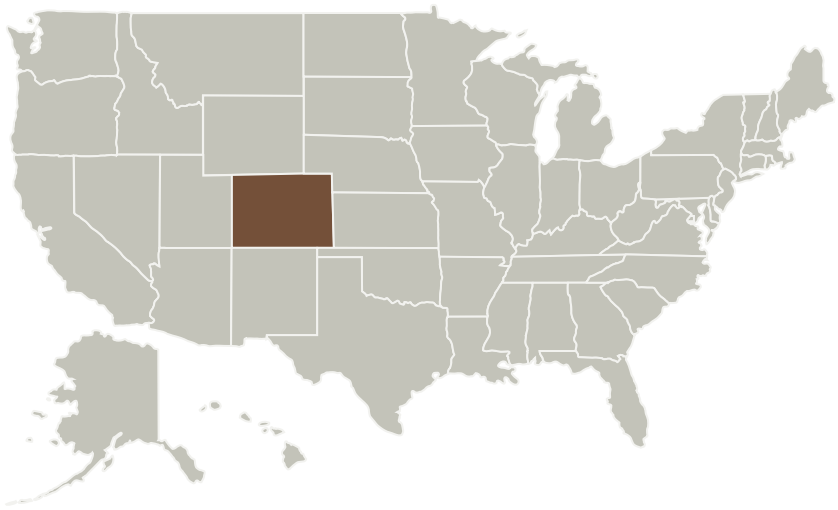
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Colorado Boulder	Lead Organization	Academia	Boulder, Colorado

Primary U.S. Work Locations
Colorado

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Colorado Boulder

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Kevin France

Co-Investigator:

Christopher G Moore

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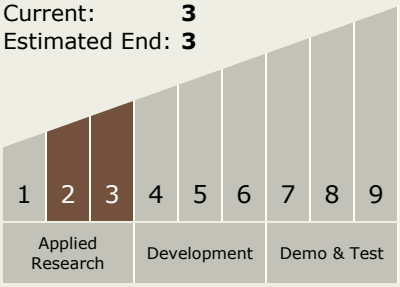
Completed Technology Project (2013 - 2017)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.5 Coatings

Target Destinations

Earth, Others Inside the Solar System, Outside the Solar System